

vibration may occur at a desired position of the display part, the vibrating position may be adjusted, and besides multiple vibrations may occur in two or more portions.

[0181] In order to achieve precise vibration, the spacing portions are formed between each vibrator and the housing, and between each vibrator and the display part. Further, the isolating material is provided on a contact portion between each vibrator and the corresponding support portion of the housing. Thereby, the vibration isolating structure for suppressing the undesirable transmission of vibration is realized.

[0182] Therefore, unlike the prior art, the haptic display apparatus having the vibration isolating structure according to the present invention is advantageous in that vibration can be generated at or moved to a desired position throughout the whole area of the display part, thus maximizing a user's convenience and effectively generating various outputs.

[0183] According to the embodiment of the present invention, each vibrator is arranged so that an excitation positions is set at the center of each edge. However, in order to more precisely control the vibrating position, two or more vibrators may be provided on each edge, and besides the vibrating point may be formed at a position adjacent to the central portion rather than the edge.

[0184] Herein, the rectangular display part has been described as one example. However, as described above, the haptic display apparatus or display part may have various shapes as necessary, may locate the vibrators at proper positions, and may control the vibrating position by a change in frequency of the individual vibrator and interaction between the vibrators. Further, it should be understood that panels providing only tactility without displaying images as well as panels displaying various kinds of images fall within the purview of the present invention.

[0185] Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

What is claimed is:

1. A locally vibrating haptic apparatus, comprising:
a panel; and
a vibrator transmitting vibration to the panel,
wherein a vibration frequency outputted from the vibrator is adjusted in a domain less than a primary resonant frequency of the panel, thus controlling a vibrating position from a portion having the vibrator to a central portion of the panel.
2. The locally vibrating haptic apparatus as set forth in claim 1, wherein the vibrator includes three or more vibrators arranged along edges of the panel, so that vibration generated at a specific position of the panel is controlled through vibration generated by each of the vibrators.
3. The locally vibrating haptic apparatus as set forth in claim 2, wherein
the panel takes a shape of a rectangular flat plate, and
the vibrators are so arranged as to transmit vibration to centers of the respective edges of the panel.
4. The locally vibrating haptic apparatus as set forth in claim 2, wherein
the panel takes a shape of a rectangular flat plate, and
the vibrators are so arranged as to transmit vibration to respective corners of the panel.

5. The locally vibrating haptic apparatus as set forth in claim 1, wherein a frequency of voltage applied to the vibrator has a triangle wave.

6. The locally vibrating haptic apparatus as set forth in claim 5, wherein a symmetry ratio of the triangle wave is selected from a shape having no frequency component that corresponds to the primary resonant frequency of the panel when a spectrum is analyzed.

7. The locally vibrating haptic apparatus as set forth in claim 2, wherein vibrations generated from the plurality of vibrators complement or cancel each other to vibrate the specific portion of the panel or to remove vibration.

8. The locally vibrating haptic apparatus as set forth in claim 7, wherein any one of the vibrators vibrates the specific portion of the panel, and at least one of remaining vibrators cancels and removes vibration of a remaining portion.

9. The locally vibrating haptic apparatus as set forth in claim 1, wherein the vibrator comprises a piezoelectric actuator.

10. The locally vibrating haptic apparatus as set forth in claim 9, wherein the vibrator comprises a bimorph-type piezoelectric actuator configured to support both ends of a vibration beam.

11. The locally vibrating haptic apparatus as set forth in claim 10, wherein the vibration beam is parallelly disposed on a lower surface of each of the edges of the panel, and a central portion of the vibration beam is connected to a center of each of the edges to transmit vibration thereto.

12. A method for locally vibrating a haptic apparatus, comprising:

- (a) determining a primary resonant frequency of a panel;
- (b) connecting a vibrator to a lower surface of an edge of the panel; and
- (c) vibrating the vibrator with a frequency less than the primary resonant frequency, thus vibrating a specific position between a central portion of the panel and the edge.

13. The method as set forth in claim 12, wherein
at (b), a plurality of vibrators is connected to edges of the panel, and

at (c), at least two vibrators selected from the plurality of vibrators are vibrated, thus vibrating a specific position of the panel.

14. The method as set forth in claim 12, wherein
at (b), the vibrators are connected to the respective edges, and

at (c), any one vibrator selected from the plurality of vibrators vibrates the panel, and at least one of remaining vibrators cancels and removes vibration from a portion except for the specific position of the panel.

15. The method as set forth in claim 12, further comprising:
moving a vibrating position by vibrating the vibrators while changing the frequency at a predetermined time interval, at (c).

16. The method as set forth in claim 12, wherein
at (b), the vibrators are connected to the respective edges, and

at (c), when a predetermined time has passed after any one vibrator is vibrated to vibrate the specific position of the panel, another vibrator is vibrated to move a vibrating position.

17. The method as set forth in claim 12, further comprising:
inputting voltage applied to each of the vibrators in a frequency of a triangle wave, at (c).